

NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

HIGHLIGHTED ARTICLES

[During El Niño, Pacific Warm Pool expands, ocean gains more heat](#)

Geophysical Research Letters (4.456)

[What history tells us about the 2015 U.S. daily rainfall extremes](#)

Bulletin of the American Meteorological Society Special Supplement (11.808)

[Warming trends and bleaching stress of the world's coral reefs 1985–2012](#)

Nature Scientific Reports (5.228)

[Seafood prices reveal impacts of a major ecological disturbance](#)

Proceedings of the National Academy of Sciences (9.423)

[Cyanobacterial harmful algal blooms are a biological disturbance to western Lake Erie bacterial communities](#)

Environmental Microbiology (5.932)

[Projections of future habitat use by Atlantic bluefin tuna: Mechanistic vs. correlative distribution models](#)

ICES Journal of Marine Science (2.626)

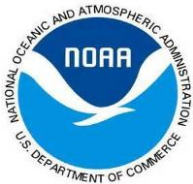
[Local-scale projections of coral reef futures and implications of the Paris Agreement](#)

Nature Scientific Reports (5.228)

CROSS LINE OFFICE ARTICLES

[Identification of three *Brucella ceti* genotypes in bottlenose dolphins \(*Tursiops truncatus*\) using a multiplex SYBR green real-time PCR](#)

Aquatic Mammals (1.015)



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

ADDITIONAL ARTICLES

NMFS Publications

[Variable vital rates and the risk of population declines in Adélie penguins from the Antarctic Peninsula region](#)

Ecosphere (2.287)

[The impact of different hatchery rearing environments on smolt to adult survival of spring chinook salmon](#)

Transactions of the American Fisheries Society (1.692)

[Spatial valuation of California marine fisheries as an ecosystem service](#)

Canadian Journal of Fisheries and Aquatic Science (2.437)

[Alteration of thyroid hormone concentrations in juvenile chinook salmon \(*Oncorhynchus tshawytscha*\) exposed to polybrominated diphenyl ethers, BDE-47 and BDE-99](#)

Chemosphere (3.137)

[Anomalous ocean conditions in 2015: Impacts on spring chinook salmon and their prey field](#)

Marine Ecology Progress Series (2.361)

[Temporal changes in the suitability of claywater as a greenwater substitute for rearing larval sablefish \(*Anoplopoma fimbria*\)](#)

Aquaculture (1.893)

[Analytical approaches to subspecies delimitation with genetic data](#)

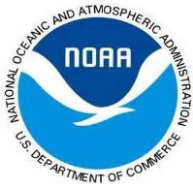
Marine Mammal Science (1.665)

[Performance of IUCN proxies for generation length](#)

Conservation Biology (4.267)

[Elucidation of the first definitively identified life cycle for a marine turtle blood fluke \(*Trematoda: Spirorchiidae*\) enables informed control](#)

International Journal of Parasitology (4.242)



NOAA SCIENTIFIC PUBLICATIONS REPORT
JANUARY 17, 2017

[Macrobenthos and megabenthos responses to long-term, large-scale hypoxia on the Louisiana continental shelf](#)

Marine Environmental Research (2.76)

[Environmental factors affecting burrowing by brown shrimp *Farfantepenaeus aztecus* and white shrimp *Litopenaeus setiferus* and their susceptibility to capture in towed nets](#)

Journal of Experimental Marine Biology and Ecology (1.866)

[Growth dynamics of juvenile loggerhead sea turtles undergoing an ontogenetic habitat shift](#)

Oecologia (3.011)

[Predator-prey interactions influenced by a dynamic river plume](#)

Canadian Journal of Fisheries and Aquatic Sciences (2.437)

[State of the California Current 2015-2016: Comparisons with the 1997-98 El Niño](#)

CalCOFI Reports (0.77)

[OAR Publications](#)

[Atmospheric mercury temporal trends in the northeastern United States from 1992 to 2014: Are measured concentrations responding to decreasing regional emissions?](#)

Environmental Science & Technology Letters (4.839)

[Improving the lake scheme within a coupled WRF-Lake model in the Laurentian Great Lakes](#)

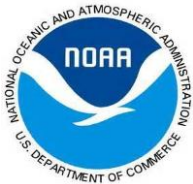
Journal of Advances in Modeling Earth Systems (5.6)

[Using calls as an indicator for Antarctic blue whale distribution and occurrence across the southwest Pacific and southeast Indian Oceans](#)

Marine Mammal Science (1.665)

[Zonal evolution of Alaskan stream structure and transport quantified with Argo data](#)

Journal of Geophysical Research: Oceans (3.44)



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

NWS Publications

[A LAMP/HRRR meld for improved aviation guidance](#)

Weather and Forecasting (1.972)

NESDIS Publications

[Validation of the effect of cross-calibrated GOES solar proton effective energies on derived integral fluxes by comparison with STEREO observations](#)

Space Weather (2.846)

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS

[qPCR assays for *Alexandrium fundyense* and *A. ostenfeldii* identified from Alaskan coastal waters and a review of species-specific *Alexandrium* molecular assays](#)

Phycologia (0.88)

[Geodetic Survey of NIST clock laboratories](#)

NOAA Technical Memorandum

HIGHLIGHTED ARTICLES

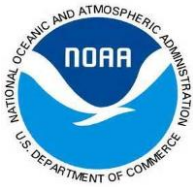
During El Niño, Pacific Warm Pool expands, ocean gains more heat

Geophysical Research Letters (4.456)

G. C. Johnson (OAR/PMEL), A. N. Birnbaum

- Analyses of Argo float temperature and satellite energy flux data illustrate redistribution and variations of heat storage with ENSO
- Monthly ocean analyses reveal large-scale ocean heat content variations while yearly analyses reveal variations in Earth's energy storage
- A 1°C increase of the Niño3.4 index corresponds to an increase of ~3.4 ZJ in Earth's energy storage, modulating the ~114 ZJ / decade trend

El Niño Southern Oscillation (ENSO) effects substantial redistributions of ocean temperature, both horizontal and vertical, on interannual time-scales, especially in the Pacific Ocean. Analyses of monthly Argo-based ocean temperature maps illustrate large-scale ocean heat content redistributions with ENSO. They quantify a globally averaged sea-surface temperature warming of ~0.1 °C with a 1 °C



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

increase of the Niño3.4 index (a moderate El Niño), a substantial perturbation to the 0.13 °C decade⁻¹ trend in sea-surface temperature. Monthly satellite-based estimates of Earth's energy imbalance suggest that a 1 °C increase of the Niño3.4 index corresponds to an increase of ~3.4 ZJ in Earth's energy storage, more gently modulating the longer-term ~114 ZJ decade⁻¹ trend. Yearly global ocean heat content estimates based on ocean temperature data, with their reduced uncertainties compared to monthly maps, reveal interannual variations in Earth's energy storage that correspond well with satellite-based estimates.

Publication date: December 28, 2016

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016GL071767/full>

What history tells us about the 2015 U.S. daily rainfall extremes

Bulletin of the American Meteorological Society Special Supplement (11.808)

K. Wolter, M. Hoerling, J. K. Eischeid, L. Cheng (OAR/ESRL)

- The United States experienced above-normal daily rainfall extremes in 2015, consistent with national upward trends
- However, the most abundant regional extremes were not foreshadowed by co-located long-term seasonal trends

Three extreme rainfall events occurred over the contiguous United States in 2015 associated with damages in excess of \$1 billion (U.S. dollars): 1) drought-ending May rains and flash floods in Texas and surrounding states (Wang et al. 2015), 2) near land-falling Hurricane Joaquin in early October associated with catastrophic flooding in South Carolina, and 3) unseasonable December rains that inundated the Mississippi basin. Recognizing the *a posteriori* nature of case study selections, we present a large-scale assessment of extreme daily rainfall events (≥ 20 -yr return threshold exceedances) over the entire contiguous United States during 2015. Our evaluation facilitates broader discussions on heavy daily precipitation by placing the 2015 high-impact events into both a national and historical context.

Publication date: December 2016

Available online: http://www.ametsoc.net/eee/2015/3_gc_precip.pdf

Warming trends and bleaching stress of the world's coral reefs 1985–2012

Nature Scientific Reports (5.228)

S. F. Heron (NESDIS/STAR), J. A. Maynard, R. van Hooidonk, C. M. Eakin (NESDIS/STAR)



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

- Using satellite temperature data, the authors show that nearly all reefs showed SST warming from 1985-2012, with 60% warming significantly, with a concurrent three-fold increase in bleaching events

Coral reefs across the world's oceans are in the midst of the longest bleaching event on record (from 2014 to at least 2016). As many of the world's reefs are remote, there is limited information on how past thermal conditions have influenced reef composition and current stress responses. Using satellite temperature data for 1985–2012, the analysis we present is the first to quantify, for global reef locations, spatial variations in warming trends, thermal stress events and temperature variability at reef-scale (~4 km). Among over 60,000 reef pixels globally, 97% show positive SST trends during the study period with 60% warming significantly. Annual trends exceeded summertime trends at most locations. This indicates that the period of summer-like temperatures has become longer through the record, with a corresponding shortening of the 'winter' reprieve from warm temperatures. The frequency of bleaching-level thermal stress increased three-fold between 1985–91 and 2006–12 – a trend climate model projections suggest will continue. The thermal history data products developed enable needed studies relating thermal history to bleaching resistance and community composition. Such analyses can help identify reefs more resilient to thermal stress.

Publication date: December 6, 2016

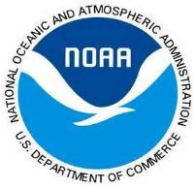
Available online: <http://www.nature.com/articles/srep38402>

Seafood prices reveal impacts of a major ecological disturbance

Proceedings of the National Academy of Sciences (9.423)

M. D. Smith, A. Oglend, J. Kirkpatrick, F. Asche, L. S. Benneer, **J. K. Craig** (NMFS/SEFSC), **J. M. Nance** (NMFS/SEFSC)

- Coastal hypoxia (low oxygen) is a growing problem worldwide, but economic consequences for fisheries are largely unknown. We provide the first evidence that hypoxia causes economic effects on a major fishery that was once the most valuable fishery in America.
- Our analysis is also a breakthrough in causal inference for coupled human-natural systems. While establishing causality with observational data is always challenging, feedbacks across the human and natural systems amplify these challenges and explain why linking hypoxia to fishery losses has been elusive.
- We offer a novel alternative approach using a market counterfactual that is immune to contamination from feedbacks in the coupled system. Natural



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

resource prices can thus be a means to assess the significance of an ecological disturbance.

Coastal hypoxia (dissolved oxygen ≤ 2 mg/l) is a growing problem worldwide that threatens marine ecosystem services, but little is known about economic effects on fisheries. Here we provide the first evidence that hypoxia causes economic impacts on a major fishery. Ecological studies of hypoxia and marine fauna suggest multiple mechanisms through which hypoxia can skew a population's size distribution toward smaller individuals. These mechanisms produce sharp predictions about changes in seafood markets. Hypoxia is hypothesized to decrease the quantity of large shrimp relative to small shrimp and increase the price of large shrimp relative to small shrimp. We test these hypotheses using time series of size-based prices. Naive quantity-based models using treatment/control comparisons in hypoxic and non-hypoxic areas produce null results, but we find strong evidence of the hypothesized effects in the relative prices; hypoxia increases the relative price of large-to-small shrimp. The effects of fuel prices provide supporting evidence. Empirical models of fishing effort and bioeconomic simulations explain why quantifying effects of hypoxia on fisheries using quantity data has been inconclusive. Specifically, spatial-dynamic feedbacks across the natural system (the fish stock) and human system (the mobile fishing fleet) confound "treated" and "control" areas. Consequently, analyses of price data, which rely on a market counterfactual, are able to reveal effects of the ecological disturbance that are obscured in quantity data. Our results are an important step toward quantifying the economic value of reduced upstream nutrient loading in the Mississippi Basin and are broadly applicable to other coupled human-natural systems.

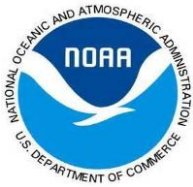
Acceptance date: December 21, 2016

Cyanobacterial harmful algal blooms are a biological disturbance to western Lake Erie bacterial communities

Environmental Microbiology (5.932)

M. A. Berry, **T. W. Davis (OAR/GLERL)**, R. M. Cory, M. B. Duhaime, **T. H. Johengen (OAR/OARO)**, G. W. Kling, J. A. Marino, P. A. Den Uyl, D. Gossiaux, G. J. Dick, V. J. Denef

- Bacterial communities associated with harmful algal blooms (HABs) in western Lake Erie are impacted primarily by changes in pH due to high biomass and photosynthesis during bloom events.



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

- However, bacterial assemblages are resilient and return to pre-bloom community composition shortly after the bloom dissipates.

Human activities are causing a global proliferation of cyanobacterial harmful algal blooms (CHABs), yet we have limited understanding of how these events affect freshwater bacterial communities. Using weekly data from western Lake Erie in 2014, we investigated how the cyanobacterial community varied over space and time, and whether the bloom affected non-cyanobacterial (nc-bacterial) diversity and composition. Cyanobacterial community composition fluctuated dynamically during the bloom, but was dominated by *Microcystis* and *Synechococcus* OTUs. The bloom's progression revealed potential impacts to nc-bacterial diversity. Nc-bacterial evenness displayed linear, unimodal, or no response to algal pigment levels, depending on the taxonomic group. In addition, the bloom coincided with a large shift in nc-bacterial community composition. These shifts could be partitioned into components predicted by pH, chlorophyll a, temperature, and water mass movements. Actinobacteria OTUs showed particularly strong correlations to bloom dynamics. AcI-C OTUs became more abundant, while acI-A and acI-B OTUs declined during the bloom, providing evidence of niche partitioning at the sub-clade level. Thus, our observations in western Lake Erie support a link between CHABs and disturbances to bacterial community diversity and composition. Additionally, the short recovery of many taxa after the bloom indicates that bacterial communities may exhibit resilience to CHABs.

Publication date: December 27, 2016

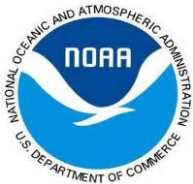
Available online: <http://onlinelibrary.wiley.com/doi/10.1111/1462-2920.13640/abstract>

Projections of future habitat use by Atlantic bluefin tuna: Mechanistic vs. correlative distribution models

ICES Journal of Marine Science (2.626)

B. A. Muhling (NOAA/GFDL), **R. Brill** (NMFS/NEFSC), **J. T. Lamkin** (NMFS/SEFSC), **M. A. Roffer**, **S.-K. Lee** (OAR/AOML), **Y. Liu** (OAR/AOML), **F. Muller-Karger**

- Two models were used to determine future distributions of Atlantic bluefin tuna.
- Both models indicated that Atlantic bluefin tuna currently inhabit favorable metabolic habitats.



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

- Results also indicate that climate change is likely to increase metabolic stress on Atlantic bluefin tuna in sub-tropical habitats, but may improve habitat suitability in subpolar habitats.

Climate change is likely to drive complex shifts in the distribution and ecology of marine species. Projections of future changes may vary, however, depending on the biological impact model used. In this study, we compared a correlative species distribution model and a simple mechanistic oxygen balance model for Atlantic bluefin tuna (*Thunnus thynnus*: ABFT) in the North Atlantic Ocean. Both models gave similar results for the recent historical time period, and suggested that ABFT generally occupy favourable metabolic habitats. Projections from an earth system model showed largely temperature-induced reductions in ABFT habitat in the tropical and sub-tropical Atlantic by 2100. However, the oxygen balance model showed more optimistic results in parts of the subpolar North Atlantic. This was partially due to an inherent ability to extrapolate beyond conditions currently encountered by pelagic longline fishing fleets. Projections included considerable uncertainty due to the simplicity of the biological models, and the coarse spatiotemporal resolution of the analyses. Despite these limitations, our results suggest that climate change is likely to increase metabolic stress on ABFT in sub-tropical habitats, but may improve habitat suitability in subpolar habitats, with implications for spawning and migratory behaviours, and availability to fishing fleets.

Publication date: December 26, 2016

Available online:

<http://icesjms.oxfordjournals.org/content/early/2016/12/25/icesjms.fsw215.abstract>

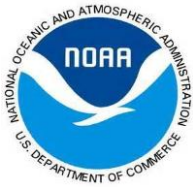
Local-scale projections of coral reef futures and implications of the Paris Agreement

Nature Scientific Reports (5.228)

R. van Hooidonk (OAR/AOML), J. Maynard, J. Tamelander, J. Gove, G. Ahmadi, L. Raymundo, G. Williams, **S. Heron (NESDIS/STAR)**, S. Planes

- Statistically downscaled global climate projections (4-km resolution) reveal high local variation in annual severe coral reef bleaching.
- The emissions pledges made after COP21 will exceed RCP4.5 by mid-century, yet >75% of reefs will still experience annual severe bleaching before 2070 under RCP4.5.

Increasingly frequent severe coral bleaching is among the greatest threats to coral reefs posed by climate change. Global climate models (GCMs) project great spatial



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

variation in the timing of annual severe bleaching (ASB) conditions; a point at which reefs are certain to change and recovery will be limited. However, previous model-resolution projections ($\sim 1 \times 1^\circ$) are too coarse to inform conservation planning. To meet the need for higher-resolution projections, we generated statistically downscaled projections (4-km resolution) for all coral reefs; these projections reveal high local-scale variation in ASB. Timing of ASB varies >10 years in 71 of the 87 countries and territories with $\geq 500 \text{ km}^2$ of reef area. Emissions scenario RCP4.5 represents lower emissions mid-century than will eventuate if pledges made following the 2015 Paris Climate Change Conference (COP21) become reality. These pledges do little to provide reefs with more time to adapt and acclimate prior to severe bleaching conditions occurring annually. RCP4.5 adds 11 years to the global average ASB timing when compared to RCP8.5; however, $>75\%$ of reefs still experience ASB before 2070 under RCP4.5. Coral reef futures clearly vary greatly among and within countries, indicating the projections warrant consideration in most reef areas during conservation and management planning.

Publication date: December 21, 2016

Available online: <http://www.nature.com/articles/srep39666>

CROSS LINE OFFICE ARTICLES

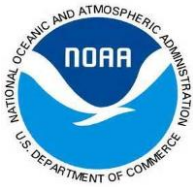
Identification of three Brucella ceti genotypes in bottlenose dolphins (Tursiops truncatus) using a multiplex SYBR green real-time PCR

Aquatic Mammals (1.015)

Q. Wu (NOS/NCCOS), W. E. McFee (NOS/NCCOS), D. Fauquier (NMFS/OPR), L. Schwacke

- To our knowledge, this study is the first report on identification of *Brucella ceti* genotypes ST26 and ST27 in dolphins using a multiplex real-time PCR assay.
- The results in this study indicate that the assay may be used as a fast and reliable alternative approach for identification of *B. ceti* in samples from dolphins.

Three sequence types (ST) of *Brucella ceti* (ST23, ST26 and ST27) in marine mammals have been identified using multilocus sequence analysis and multilocus variable number tandem repeat analysis. This study reports a multiplex SYBR green real-time PCR assay and melting curve analysis for rapid identification of these *B. ceti* strains and application to test clinical samples from 272 bottlenose dolphins (*Tursiops truncatus*) stranded in the coastal region of northern Florida,



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

South Carolina and Virginia, USA. The multiplex real-time PCR assay detected all *B. ceti* ST23, ST26 and ST27 strains and field isolates and none of other *Brucella* spp. and non-*Brucella* pathogens tested. The limit of detection was 15 genome copies from *B. ceti* B1/94 (ST23), *B. ceti* B14-94 (ST26) and *B. ceti* SC1135 (ST27) per PCR volume. *Brucella* DNA fragments specific for ST26 and ST27 were found in 15% (41/272) and 7% (20/272) of dolphin samples, respectively. No specific fragment of *Brucella* DNA for ST23 was detected in these samples. The presence of the gene fragments specific for ST26 and ST27 in positive samples observed with multiplex real-time PCR was further confirmed by conventional PCR, consisting of a set of six specific PCRs, targeting IS711-specific chromosomal locations for *Brucella* in marine mammals. To our knowledge, this study is the first report on identification of *B. ceti* genotypes ST26 and ST27 in dolphins using a multiplex real-time PCR assay. The results in this study indicate that the assay may be used as a fast and reliable alternative approach for identification of *B. ceti* in samples from dolphins.

Acceptance date: December 19, 2016

ADDITIONAL ARTICLES

NMFS Publications

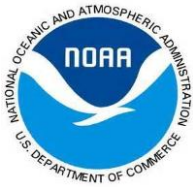
Variable vital rates and the risk of population declines in Adélie penguins from the Antarctic Peninsula region

Ecosphere (2.287)

J. T. Hinke (NMFS/SWFSC), S. G. Trivelpiece, W. Z. Trivelpiece

- The Antarctic Peninsula environment is undergoing many physical changes, which, in conjunction with the marginal effects of management action on Adélie penguin populations growth rates of these populations may be difficult to assess.
- With expectations of continued environmental and ecosystem changes in the northern Antarctic Peninsula region it is expected that Adélie penguin population sizes in these regions will continue to decline.

Predicting population responses in changing environments is an important task for ecologists. In polar regions, climate warming, loss of sea ice, and more frequent anomalous events suggest that further reductions in ice-dependent animal populations are likely. We assess the risk of near-term (30 year) depletion of an Adélie penguin (*Pygoscelis adeliae*) population with a stochastic matrix model parameterized with 30 years (1982-2011) of data from the Copacabana colony on



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

King George Island, Antarctica. The model was fitted to nest census data by estimating correction factors for survival rates estimated from a multi-state mark-recapture model. We modeled future survival and fecundity scenarios during the projection period (2012-2041) based on a two-state Markov chain that randomly assigned survival rates and reproductive success from their respective historical distributions to represent “good” and “poor” years. Monte Carlo simulation was used to estimate population trajectories across a range of progressively worse survival conditions. The results suggest that, given historical distributions of survival and reproductive success, a limited scope for recovery of the population is present, commensurate with recent stabilization in population size at the study site. However, our projections mainly suggest that the Adélie penguin population will decline if the frequency of years with poor survival remains at, or increases above, its 30-year mean. The risk of local depletion within 30 years, defined according to IUCN categories for endangered and critically endangered species, was 33% for >90% declines, but near 100% for 50% declines given status-quo conditions. As survival conditions worsen, the risk of substantive depletions rose rapidly. Given expectations of further environmental and ecosystem changes in the northern Antarctic Peninsula region, continued declines in Adélie penguin population size at the northern extent of their range should be expected.

Publication date: January 11, 2017

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/ecs2.1666/full>

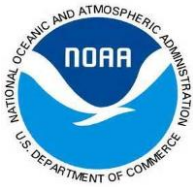
The impact of different hatchery rearing environments on smolt to adult survival of spring chinook salmon

Transactions of the American Fisheries Society (1.692)

B. R. Beckman, D. L. Harstad, D. K. Spangenberg, R. S. Gerstenberger, C. Brun, D. A. Larsen (NMFS/NWFSC)

- Differences in hatchery rearing regimes result in different smolt survival rates from three groups of Hood River Chinook salmon reared at three different salmon hatcheries and then released into the Hood River across three separate years.
- Adult salmon production might be increased by improving rearing regimes.
- The efficiencies of different hatcheries can be quantitatively evaluated and compared for optimal Chinook salmon rearing.

A study was conducted to assess the effect of differing hatchery rearing environments on smolting, early male maturation and smolt-to-adult return rates



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

(SARs) in Chinook Salmon *Oncorhynchus tshawytscha*. In this report, SARs were compared for three groups of Hood River stock spring Chinook salmon reared at three different salmon hatcheries and then released into the Hood River across three separate years (2010-2012). Differences in SAR were found both between rearing groups and release years. Smolts reared at Pelton Ladder had consistently higher SARs than those reared at either Parkdale or Carson hatcheries. Smolt length at release was significantly correlated to SAR across years and rearing groups. In addition, multiple regression models suggested that attributes related to the intensity of smolting were positively related to SAR (gill Na⁺, K⁺-ATPase activity, condition factor) while minijack rate was negatively related to SAR. Migration of smolts downstream, post-release was also assessed. Larger smolts migrated downstream at a greater rate and migration pace was positively related to subsequent SAR. Differences in migration and SAR between rearing groups is attributed to differing patterns of growth in the different hatchery environments. The best performing smolts came from rearing groups that experienced a strong seasonal change in growth rate; relatively high growth in the summer, reduced growth and depletion of energetic stores in the autumn and winter and then increased growth again in the spring. This pattern of seasonal anabolic and catabolic change has been termed the wild fish template. The applicability of generating this physiological pattern generally in Chinook salmon hatcheries is discussed.

Acceptance date: December 20, 2016

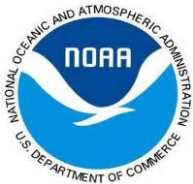
Spatial valuation of California marine fisheries as an ecosystem service

Canadian Journal of Fisheries and Aquatic Science (2.437)

R. R. Miller, J. C. Field, J. A. Santora, M. H. Monk, R. Kosaka, C. Thomson (NMFS/SWFSC)

- Manuscript represents a greatly improved understanding of the spatial distribution of historically important fishing grounds in California for commercial fishery catch and value based on historical block summary data.
- Manuscript also provides a statistical description (non-metric multidimensional scaling) of the spatial organization and center of abundance of species assemblages landed in California waters. Results serve as a regional baseline for fisheries ecosystem service and benefits that could be used for diagnostic trade-offs with other ocean uses and services.

Quantifying spatiotemporal dynamics of ecosystem services is an emerging approach for informing and managing tradeoffs among cumulative or competing



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

activities in marine environments. As one proxy for ecosystem services and benefits, we quantified and mapped catch and economic value of California commercial fisheries removals using a 75-year spatially-explicit time series. From 1931-2005, approximately 88% of the catch was attributed to finfish. However, there has been an increasing reliance of proportional value from invertebrates, over the last 25 years. The spatial organization of historical catches suggests species composition varies substantially by depth and latitude, and an evaluation of changes in the spatial distribution of catches in three different time periods suggests that spatial shifts in catch locations have occurred for some taxonomic groups over time. A spatial assessment of historical catches and value benefits marine spatial planning, informs stock assessments, provides a quantification of ecosystem services, and facilitates ecosystem-based approaches to marine fisheries management.

Acceptance date: December 12, 2016

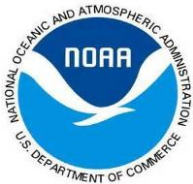
Alteration of thyroid hormone concentrations in juvenile Chinook salmon (Oncorhynchus tshawytscha) exposed to polybrominated diphenyl ethers, BDE-47 and BDE-99

Chemosphere (3.137)

M. R. Arkoosh (NMFS/NWFSC), A. L. Van Gaest, S. A. Strickland, G. P. Hutchinson, A. B. Krupkin, **J. P. Dietrich (NMFS/NWFSC)**

- Flame-retardants are detected in salmon globally
- Polybrominated diphenyl ethers (PBDEs) alters circulating thyroid hormone concentrations and has the potential to impact a number of critical functions in juvenile salmon including growth, parr-smolt transformation, and immunological processes.
- Important for the recovery and rebuilding of marine coastal species

Polybrominated diphenyl ethers (PBDEs) have been used as flame-retardants in consumer products and are currently detected in salmon globally, from farmed Atlantic salmon to wild threatened/endangered Pacific salmon. The two most predominant PBDE congeners found in these salmon are BDE-47 (2,2',4,4'-tetrabromodiphenyl ether) and BDE-99 (2,2',4,4',5-pentabromodiphenyl ether). In the present study, groups of juvenile Pacific Chinook salmon were fed five environmentally relevant concentrations of either BDE-47 (0.3-552 ng total PBDEs/g food), BDE-99 (0.3-580 ng total PBDEs/g food), or nearly equal mixtures of both congeners (0.7-690 ng total PBDEs/g food) for 39-40 days. The concentrations of circulating total thyroid hormones, thyroxine (T₄) and 3,5,3'-



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

triiodothyronine (T_3), were then measured to determine if PBDE exposure disrupts the hypothalamic-pituitary-thyroid endocrine axis. Circulating concentrations of total T_4 and T_3 in the plasma of salmon were determined using a hormone-specific time-resolved fluoroimmunoassay. The concentrations of both T_4 and T_3 were altered by dietary uptake of BDE-99. Juvenile fish with whole body concentrations of 24.1 ng total PBDEs/g wet weight (ww) had decreased circulating T_4 relative to those with lower whole body concentrations of PBDEs (2.1 and 6.8 ng total PBDEs/g ww). T_3 levels were significantly lower in fish exposed to the greatest concentration of BDE-99 in their diet (219 ng total PBDE/g ww) relative to BDE-99 fed fish with whole body concentrations of 24.1 ng total PBDE/g ww. Exposure to BDE-47 alone did not alter either T_3 or T_4 circulating hormone concentrations. However, exposure to a mixture of BDE-47 and BDE-99 reduced T_3 in fish with lower concentrations of total whole body PBDEs than with either congener alone at equivalent PBDE whole body concentrations. Accordingly, the disruption of PBDEs on circulating thyroid hormone concentrations has the potential to impact a number of critical functions in juvenile salmon including growth, parr-smolt transformation, and immunological processes. Publication date: December 8, 2016

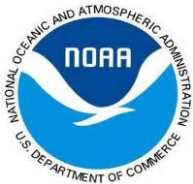
Available online: <http://dx.doi.org/10.1016/j.chemosphere.2016.12.035>

Anomalous ocean conditions in 2015: Impacts on spring Chinook salmon and their prey field

Marine Ecology Progress Series (2.361)

E. A. Daly, **R. D. Brodeur** (NMFS/NWFSC), T. D. Auth

- This study reports anomalous diets and feeding intensity in the warm blob year of 2015 off Oregon and Washington.
- Results show major changes in oceanographic conditions and prey availability. Anomalous warm ocean conditions persisted throughout winter, spring, and summer during most of 2015 ($> 2.5^{\circ}\text{C}$ above normal) occurring during the winter period when the fish prey resources of juvenile salmon developed and in the spring and summer as the salmon entered the ocean. The biomass of ichthyoplankton in January-March is inversely related to October-December PDO conditions the prior year and positively related to adult salmon returns several years later. The biomass of ichthyoplankton in winter 2015 was the 4th highest of the 18 year time-series, which predicts good food conditions for juvenile salmon. The increased biomass was primarily due to abnormally high biomasses of northern anchovy (*Engraulis mordax*) and rockfish (*Sebastes spp.*) larvae, which are warm water taxa and when



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present in the winter typically predicts poor returns of salmon. May diets of juvenile Chinook salmon (*Oncorhynchus tshawytscha*) collected in coastal waters of the northern California Current reflected higher proportions of juvenile rockfish being eaten, but no evidence of northern anchovies being consumed despite their being found in unusually high biomass in the winter. The May Chinook salmon diet composition most closely resembled those of other warm years of our study period. June diets also reflected a warm prey community being consumed with higher amounts of juvenile rockfish, crab megalopae, and juvenile northern anchovies being eaten, predicting poor returns of adult salmon based on diet composition. Both May and June Chinook salmon had one of the highest percentages of empty stomachs, but overall stomach fullness was average for May but low in June. The salmon were small and thin in 2015, and residuals of length-weight relationships showed Chinook salmon were below average weight for their length in 2015, weighing 17.6% less than the same size fish in a cold ocean year (2008). Higher condition or fatness of Chinook salmon relates to increased adult returns two years later, which suggests that the prospects for the 2015 ocean-entry smolts are not favorable.

Acceptance date: December 14, 2016

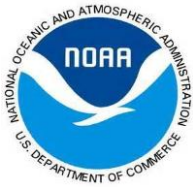
Temporal changes in the suitability of claywater as a greenwater substitute for rearing larval sablefish (Anoplopoma fimbria)

Aquaculture (1.893)

J. S. F. Lee, M. A. Cook, B. A. Berejikian, F. W. Goetz (NMFS/NWFSC)

- The authors experimented with replacing algae with clay to make “greenwater” at different stages in larval development.
- Clay replacement reduced survival in the first week of larval rearing, but a switch from algae to clay in the second week improved larval growth.
- Replacing algae with clay has the potential to reduce costs and increase production for fish hatcheries.

For some species, marine aquaculture facilities increase turbidity to improve larval feeding, growth, and survival, typically by mixing algae with seawater to make “greenwater.” Clay is a less expensive and inorganic potential algae substitute that has been shown to reduce bacterial levels relative to algae and promote equal or better growth and survival in some species. Sablefish (*Anoplopoma fimbria*) is a prime candidate species for aquaculture but the rearing of sablefish larvae has not yet been experimentally tested with clay. This study tested whether clay is a viable algae substitute for rearing sablefish, and whether the relative performance of clay



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versus algae varies as a function of time. In the first week of larval rearing, algae produced more than three times greater survival than clay. However switching from algae to clay at the beginning of the second week led to 1.5 times greater larval growth compared to tanks where algae was used in both weeks. The performance difference between clay and algae, despite equal turbidity, suggests that clay and algae have potentially harmful and beneficial effects in addition to turbidity effects, and that these effects change through time. However because the first experiment was a replacement study, it was not possible to know whether algae produced better survival in week one because 1) clay, which might be harmful, was not present, 2) algae, which might be beneficial, was present, or 3) both. A further additive study was conducted to test the second possibility. The experiment found that adding algae to clay in the first week of larval rearing leads to greater growth and survival, suggesting that algae has beneficial effects beyond turbidity. The authors discuss some possible mechanisms for potential harmful and beneficial effects of algae and clay.

Acceptance date: December 7, 2016

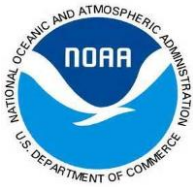
Analytical approaches to subspecies delimitation with genetic data

Marine Mammal Science (1.665)

K. K. Martien (NMFS/SWFSC), M. S. Leslie (NMFS/SWFSC), B. L. Taylor (NMFS/SWFSC), P. A. Morin (NMFS/SWFSC), F. I. Archer (NMFS/SWFSC), B. L. Hancock-Hanser (NMFS/SWFSC), P. E. Rosel (NMFS/SEFSC), N. L. Vollmer (NMFS/OST), A. Viricel, F. Cipriano

- Second paper of special issue of 6 papers that develops a rationale for and definition of ‘subspecies’
- Reviews analytical approaches for delimiting subspecies and the potential for under- and over-classification associated with each approach

The vast and remote distributions and large body size of most cetaceans make it difficult to obtain and maintain morphological collections adequate for advancing sound taxonomic arguments. Consequently, genetic data are playing an increasingly important role in cetacean species and subspecies delimitation. We review seven categories of analytical methods useful in delimiting subspecies based on genetic data. For each category, we summarize its utility in evaluating putative subspecies, the types of markers to which it can be applied, and potential challenges in interpreting results in a taxonomic context. We focus on the utility of each type of method to evaluate the critical features distinguishing subspecies from populations and species: the degree of diagnosability between putative taxa and the



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extent to which the putative taxa have diverged along separate evolutionary pathways. We conclude that diagnosability is best estimated with either assignment tests or multivariate methods, while evaluating the degree of divergence requires a synthesis of multiple lines of evidence derived from different analytical methods and different data types, including nongenetic data.

Acceptance date: December 8, 2016

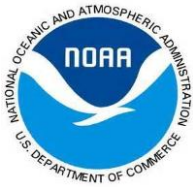
Performance of IUCN proxies for generation length

Conservation Biology (4.267)

H. C. Fung, **R. S. Waples** (NMFS/NWFSC)

- Generation length (T) plays an important role in determining extinction risk under the IUCN framework and also influences risk assessments under the ESA.
- Because accurate calculation of T requires detailed data that are seldom available, simple proxies based on generic life history traits are routinely used.
- We show analytically and with empirical data for 78 species that some simple adjustments to IUCN proxies can improve their performance

A criterion commonly used to assess conservation risk by the International Union for Conservation of Nature (IUCN) is the rate of decline in abundance, calculated over 3 generations or 10 years, whichever is longer. The traditional method for calculating generation length (T) uses age-specific survival and fecundity, but these data are rarely available. Consequently, proxies that require less information are often used, which introduces potential biases. Two proxies recommended by the IUCN are the adult-mortality proxy, $T^d = a + 1/d$, and the reproductive-lifespan proxy, $T^z = a + z \cdot RL$, where a = age at first reproduction, d = adult mortality rate, RL = reproductive lifespan, and z is a coefficient derived from data for comparable species. We evaluated performance of each proxy using published life tables for 78 animal and plant species. Mean error rates in estimating T were 31% for T^d and 20% for T^z , but error rates for the adult-mortality proxy dropped to 16% when it was adjusted by subtracting one year ($T^{d(adj)} = a - 1 + 1/d$), as suggested by theory; $T^{d(adj)}$ also provided largely unbiased estimates regardless of the true generation length. Performance of T^z depends on having detailed data for comparable species, but our results suggest taxonomy is not a reliable indicator of comparability. All three proxies depend heavily on a reliable estimate of age at first reproduction, as we illustrated by creating mock conservation assessments for two species (desert tortoise and bocaccio rockfish). The relatively large mean errors, even for $T^{d(adj)}$, emphasize the importance of collecting the detailed life



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

history information necessary to calculate true generation length in species of conservation concern. Unfortunately, publication of such data is less common than it was several decades ago. We identified generic patterns of age-specific change in vital rates that can be used to predict expected patterns of bias from applying $T^d(\text{adj})$.

Acceptance date: December 19, 2016

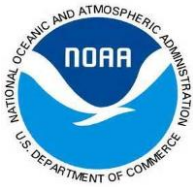
Elucidation of the first definitively identified life cycle for a marine turtle blood fluke (Trematoda: Spirorchiidae) enables informed control

International Journal of Parasitology (4.242)

T. H. Cribb, J. L. Crespo-Picazo, S. C. Cutmore, **B. A. Stacy (NMFS/OPR)**, P. A. Chapman, D. García-Párraga

- Spirorchiid trematodes (blood flukes) are one of the most important known causes of disease in sea turtles.
- This paper reports the discovery of a life cycle, all of which were previously unknown.
- This finding is significant advancement in our understanding of these parasites and an important discovery related to sea turtle health and disease.

Blood flukes of the family Spirorchiidae are significant pathogens of both free-ranging and captive marine turtles. Despite a significant proportion of marine turtle mortality being attributable to spirorchiid infections, details of their life cycles remain almost entirely unknown. Here we report on the molecular elucidation of the complete life cycle of a marine spirorchiid, identified as *Amphiorchis* sp., infecting vermetid gastropods and captive bred neonate *Caretta caretta* in the Oceanogràfic Aquarium, in Valencia, Spain. Specimens of a vermetid gastropod, *Thylaeodus* cf. *rugulosus* (Monterosato, 1878), collected from the aquarium filtration system housing diseased *C. caretta*, were infected with sporocysts and cercariae consistent with the family Spirorchiidae. We generated rDNA sequence data (internal transcribed spacer 2 (ITS2) and partial 28S rDNA) from infections from the vermetid which were identical to sequences generated from eggs from the serosa of the intestine of neonate *C. caretta*, and an adult spirorchiid from the liver of a *C. caretta* from Florida, USA. Given the reliability of these markers in the delineation of trematode species, we consider all three stages to represent the same species and tentatively identify it as a species of *Amphiorchis* Price, 1934. The source of infection at the Oceanogràfic Foundation Rehabilitation Centre, Valencia, Spain, is inferred to be an adult *C. caretta* from the western Mediterranean being rehabilitated in the same facility. Phylogenetic



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analysis suggests that this *Amphiorchis sp.* is closely related to other spirorchiids of marine turtles (species of *Caretta* Manter and Larson, 1950, *Haplotrema* Looss, 1899 and *Learedius* Price, 1934). We discuss implications of the present findings for the control of spirorchiidiasis in captivity, for the better understanding of epidemiology in wild individuals, and the elucidation of further life cycles.

Publication date: December 18, 2016

Available Online:

<http://www.sciencedirect.com/science/article/pii/S0020751916302727>

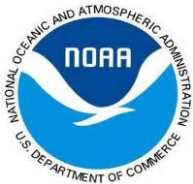
Macrobenthos and megabenthos responses to long-term, large-scale hypoxia on the Louisiana continental shelf

Marine Environmental Research (2.76)

K. Briggs, S. Shivarudrappa, **J. K. Craig** (NMFS/SEFSC), T. M. Richardhelf

- Community dynamics of macrobenthic invertebrates and demersal fishes vary in relation to the severity of seasonal hypoxia in the northern Gulf of Mexico.
- The macrobenthic response is driven by tolerance to low dissolved oxygen while the fish community response is driven by emigration and prey availability.
- This work increases understanding of hypoxia effects on trophic linkages between benthic prey and upper trophic levels important to regional fisheries.

The macrobenthos and megabenthos responses to long-term, recurring hypoxia on the Louisiana continental shelf were compared at four locations with different historical (2000 – 2010) episodes of annual exposure to bottom-water hypoxia. Measurements of abundance, biomass, species diversity, and community composition of the two size classes of benthos suggested that the macrobenthic response is driven chiefly by tolerance to hypoxia, whereas the megabenthic response was affected by the ability to migrate and the availability/unavailability of macrobenthos prey at the sediment surface. The site exposed to the historically lowest average bottom-water dissolved oxygen (BWDO) concentration exhibited the lowest species diversity for macrobenthos and the highest species diversity for megabenthos, exemplifying the differential effects of hypoxia on different size classes. The high diversity and smaller average size of the megabenthos at the lowest DO site was due to high abundance of invertebrates and a preponderance of small, less vagile fishes that appeared to remain in the area after larger dominant sciaenids had presumably emigrated. The average size and the depth of habitation in the sediment of macrobenthos prey may have also influenced the abundance and biomass of megabenthos foragers.



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JANUARY 17, 2017

Publication date: November 23, 2016

Available online:

<http://www.sciencedirect.com/science/article/pii/S0141113616302951>

Environmental factors affecting burrowing by brown shrimp Farfantepenaeus aztecus and white shrimp Litopenaeus setiferus and their susceptibility to capture in towed nets

Journal of Experimental Marine Biology and Ecology (1.866)

T. Minello (NMFS/SEFSC)

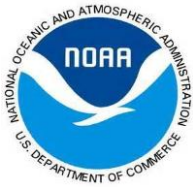
- Burrowing behavior of penaeid shrimp is affected by environmental characteristics
- Burrowing also affects capture efficiency in towed nets
- Abundance estimates from nets could be adjusted to correct for this behavior

Laboratory experiments were conducted under simulated daytime conditions to examine the effects of salinity, sediment texture, size, density, and hunger on burrowing behavior of juvenile brown shrimp *Farfantepenaeus aztecus* and white shrimp *Litopenaeus setiferus*. Over all experimental conditions (20,929 observations of 2411 individual shrimp), 77.5% of brown shrimp and 21.4% of white shrimp were observed burrowed with more than half of their body beneath the substrate. The tendency of burrowed shrimp to emerge from burrows when disturbed also was tested. When burrowing rates were examined in combination with this tendency to emerge upon disturbance, only 46.7% of brown shrimp would be susceptible to capture in towed nets, while almost all (97%) white shrimp would be susceptible. All environmental factors examined in this study, except salinity for white shrimp, significantly affected burrowing of these species. When these environmental effects on burrowing were combined with the likelihood of emergence, the effects of salinity and substrate type on brown shrimp behavior appeared most likely to affect capture by towed nets. Estuarine abundance indices from resource surveys using towed nets could be adjusted using such vulnerability estimates.

Publication date: November 2, 2016

Available online:

<http://www.sciencedirect.com/science/article/pii/S0022098116301915>



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Growth dynamics of juvenile loggerhead sea turtles undergoing an ontogenetic habitat shift

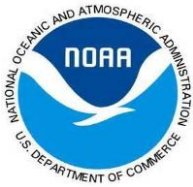
Oecologia (3.011)

M. D. Ramirez, L. Avens (NMFS/SEFSC), J. A. Seminoff (NMFS/SWFSC), L. R. Goshe (NMFS/SEFSC), S. S. Heppell

- Integration of skeletochronology and stable isotope analysis allowed for the first time evaluation of growth patterns relative to individual resource and habitat use for loggerhead sea turtles in the western North Atlantic.
- Somatic growth patterns were similar among individuals displaying different resource use and habitat shift patterns, indicating alternate strategies are likely to result in comparable size-at-age relationships and age at maturation.

Ontogenetic niche theory predicts individuals may undergo one or more changes in habitat or diet throughout their lifetime to maintain optimal growth rates, or to optimize tradeoffs between mortality risk and growth. We combine skeletochronological and stable nitrogen isotope ($\delta^{15}\text{N}$) analyses of sea turtle humeri ($n = 61$) to characterize the growth dynamics of juvenile loggerhead sea turtles (*Caretta caretta*) during an oceanic-to-neritic ontogenetic shift. The primary objective of this study was to determine how ontogenetic niche theory extends to sea turtles, and to individuals with different patterns of resource use (discrete shifters, $n = 23$; facultative shifters $n = 14$; non-shifters, $n = 24$). Mean growth rates peaked at the start of an ontogenetic shift (based on change in $\delta^{15}\text{N}$ values), but returned to pre-shift levels within two years. Turtles generally only exhibited one year of relatively high growth, but the timing of peak growth relative to the start of an ontogenetic shift varied greatly among individuals (before, $n = 14$; during, $n = 12$; after, $n = 8$). Furthermore, no reduction in growth preceded the transition, as is predicted by ontogenetic niche theory. Annual growth rates were also similar between non-transitioning turtles resident in oceanic and neritic habitats and turtles displaying alternative patterns of resource use. These results suggest factors other than maximization of size-specific growth may more strongly influence the timing of ontogenetic shifts in loggerhead sea turtles, and that alternative patterns of resource use may have limited influence on somatic growth and age-at-maturation in this species.

Accepted date: January 3, 2017



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Predator-prey interactions influenced by a dynamic river plume

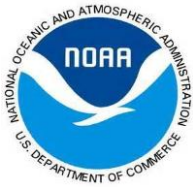
Canadian Journal of Fisheries and Aquatic Sciences (2.437)

E. M. Phillips, **J. K. Horne (NMFS/AFSC)**, **J. E. Zamon (NMFS/NWFSC)**

- The size and location of the Columbia River Plume influences the spatial distribution of fish-eating seabird predators and their forage fish prey.
- Seabird densities increase as plume size decreases, suggesting birds aggregate near the plume for feeding purposes.
- This coupling between plume size/shape and predator-prey distributions suggests that variation in river discharge may influence survival of ESA-listed juvenile salmon through changes in ocean avian predation pressure

Marine predators often rely on physical processes to locate aggregated prey in a relatively featureless environment. Freshwater flow into the ocean forms buoyant plumes and density fronts that aggregate zooplankton and larval fish. Observations of piscivorous seabirds and pelagic prey fish (i.e., forage fish) near the mouth of the Columbia River suggest that river plumes may be important areas for predator-prey interactions. We examined density distributions of seabirds and prey fish near the Columbia River plume to determine if variation in plume volume, area or location influences predator-prey interactions. Common murre *Uria aalge*, sooty shearwater *Puffinus griseus*, and fish including northern anchovy *Engraulis mordax* and juvenile salmon *Oncorhynchus spp.* occurred in plume waters (defined by surface salinity ≤ 28 practical salinity units) disproportionate to area surveyed. Murres occurred within 20 km of the plume center of gravity (CG) and were associated with increased density and diversity of non-prey organisms near the surface. Shearwaters occurred ~ 100 km to the north of the plume CG, where highest densities of prey fish were observed. Overall global indices of collocation (GIC) were < 0.7 between murres and prey, whereas GICs were ≥ 0.7 between shearwaters and prey including juvenile salmon, suggesting increased predation near the northern edge of the river plume. Although prey densities did not vary with plume volume, seabird densities were negatively correlated with both plume volume and surface area, suggesting that seabirds utilize the Columbia River plume to maximize prey encounter rates, which are available under varying plume conditions. We conclude that variation in Columbia River plume size influences predation pressure on prey including threatened salmonid species.

Acceptance date: December 21, 2016



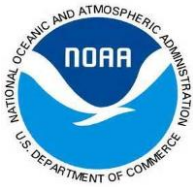
NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

State of the California Current 2015-2016: Comparisons with the 1997-98 El Niño CalCOFI Reports (0.77)

S. McClatchie (NMFS/SWFSC), R. Goericke, A. Leising (NMFS/SWFSC), T. D. Auth, E. Bjorkstedt (NMFS/SWFSC), R. R. Robertson (NMFS/SWFSC), R. D. Brodeur (NMFS/NWFSC), X. Du, E. A. Daly (NMFS/NWFSC), C. A. Morgan (NMFS/NWFSC), F. P. Chavez, A. J. Debich, J. Hildebrand, J. Field (NMFS/SWFSC), K. Sakuma (NMFS/SWFSC), M. G. Jacox (NMFS/SWFSC), M. Kahru, R. Kudela, C. Anderson, B. E. Lavaniegas, J. Gomez-Valdes, S. P. A. Jimenez-Rosenberg, R. McCabe, S. R. Melin (NMFS/AFSC), M. D. Ohman, L. M. Sala, B. Peterson (NMFS/NWFSC), J. Fisher (NMFS/NWFSC), I. D. Schroeder (NMFS/SWFSC), S. J. Bograd (NMFS/SWFSC), E. L. Hazen (NMFS/SWFSC), S. R. Schneider, R. T. Golightly, R. M. Suryan, A. J. Gladics, S. Lored, J. M. Porquez, A. R. Thompson (NMFS/SWFSC), E. D. Weber (NMFS/SWFSC), W. Watson (NMFS/SWFSC), V. Trainer (NMFS/NWFSC), P. Warzybok, R. Bradley, J. Jahncke

- The area affected by the marine heatwave and the 2015-2016 El Niño in the mixed layer was comparable to the 1997-1998 El Niño, but lasted longer.
- Warm ocean conditions, stratification, nutrient suppression, and silicic acid stress likely favored initiation of a toxic *Pseudo-nitzschia* bloom in fall 2014.
- Unusual copepod vagrants of 2015-2016 off Oregon originated from an offshore and southwesterly source; an important difference from the southerly origin of vagrants during the 1997-1998 El Niño.
- Forage fish (Pacific herring, northern anchovy and Pacific sardine) were much less abundant in 2015-2016 compared to previous years.

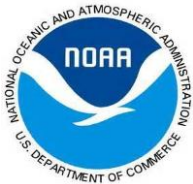
Warm conditions in the North Pacific in 2014-2015 were a result of the continuation of the North Pacific marine heatwave, a large area of exceptionally high SST anomalies that originated in the Gulf of Alaska in late 2013. The North Pacific heatwave conditions interacted with an El Niño developing in the equatorial Pacific in 2015. Weekly periods of exceptionally high temperature anomalies ($> 2^{\circ}\text{C}$) occurred until the start of the El Niño (winter of 2015), when SSTs were still high but not as high as those due to the marine heatwave. During the 2015-2016 El Niño, the depth of the 26.0 kg m^{-3} isopycnal ($d_{26.0}$) was considerably shallower than during the 1982-83 and 1997-98 events. The area affected by the marine heatwave and the 2015-2016 El Niño in the mixed layer was comparable to the 1997-1998 El Niño, but lasted longer. Water column stratification in the upper 100 m during 2015-2016 was as strong as the most extreme values during the 1997-1998 El Niño. This stratification was primarily



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driven by the warming of the upper 100 m. Despite notable perturbations, the effects of the 2015-2016 El Niño on hydrographic properties in the CalCOFI domain were not as strong as those observed during the 1997-1998 El Niño. Warm ocean conditions, stratification, nutrient suppression, and silicic acid stress likely favored initiation of a toxic *Pseudo-nitzschia* bloom in fall 2014. Very low zooplankton displacement volumes were associated with anomalously warm and saline surface waters off Baja California. In contrast, during the 1997-1998 El Niño, zooplankton volume was near average. In California, pelagic red crab (*Pleuroncodes planipes*) adults were abundant in the water column and frequently washed up on beaches of southern California from January 2015 into 2016, and central California by September 2015. Glider measurements of integrated transport up to June 2015 did not detect anomalous northward advection. As expected, HF radar indicated northward surface currents along the central California coast in fall and winter 2015-2016. Northward advection appeared to be much stronger during the 1997-1998 El Niño. Throughout 2015-2016, the zooplankton community on the Oregon shelf was dominated by lipid-poor tropical and sub-tropical copepods and gelatinous zooplankton, indicating poor feeding conditions for small fishes that are prey for juvenile salmon. The presence of rarely encountered species increased copepod species richness during 2015-2016 to levels higher than the 1998 El Niño. We infer that the unusual copepod vagrants of 2015-2016 originated from an offshore and southwesterly source; an important difference from the southerly origin of vagrants during the 1997-1998 El Niño. The very warm conditions caused sardine spawning to shift from central California to Oregon. Mesopelagic fish assemblage off southern California exhibited higher abundances of species with southern affinities, and lower abundances of species with northern affinities. Forage fish (Pacific herring, northern anchovy and Pacific sardine) were much less abundant in 2015-2016 compared to previous years. In contrast, catches of salmon were close to average off northern California. Catches of young-of-the-year rockfishes were high off central California, but low off both northern and southern California. Seabirds at Southeast Farallon Island in 2015 exhibited reduced breeding populations, reduced breeding success, lower chick growth rates, and lower fledging weights. Common murrelets were negatively affected in central and northern California, but seabird responses were species-specific. It is clear from the results presented here that the warm anomaly effects on the ecosystem were complicated, regionally specific, and that we do not fully understand them yet.

Publication date: January 3, 2017



NOAA SCIENTIFIC PUBLICATIONS REPORT JANUARY 17, 2017

Available Online: http://calcofi.org/publications/calcofireports/v57/Vol57-SOTCC_pages.5-61.pdf

OAR Publications

Atmospheric mercury temporal trends in the northeastern United States from 1992 to 2014: Are measured concentrations responding to decreasing regional emissions?

Environmental Science & Technology Letters (4.839)

H. Zhou, C. Zhou, M. M. Lynam, J. T. Dvonch, J. A. Barres, P. K. Hopke, **M. Cohen (OAR/ARL)**, T. M. Holsen

- Mercury concentrations in air and precipitation have decreased at the two sites studied.
- The most likely reason for the decrease in atmospheric mercury concentrations was the decrease in regional and national mercury emissions showing that regional emissions decreases can have regional effects.

The relative contribution of global, national, and regional mercury emissions sources to atmospheric mercury concentrations and deposition in the U.S. is an important policy-relevant question, as it influences decisions regarding regulation of regional/national sources. If the global contribution dominates, then it can be argued that the reduction of regional/national emissions is not a high priority. Unfortunately, the relative contribution of global vs. regional/national emissions sources to mercury contamination in the U.S. has been a matter of scientific debate over many years. In the past few years, an emerging scientific consensus is developing that suggests, based on the evidence, that regional/national sources can generally have a significant impact. This paper is an important contribution that adds to the evidence that regional/national sources can have an important impact. Thus, the argument that these sources should be targets for reduction is strengthened.

Publication date: December 27, 2016

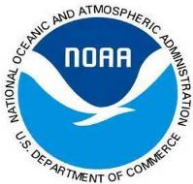
Available online: <http://pubs.acs.org/doi/abs/10.1021/acs.estlett.6b00452>

Improving the lake scheme within a coupled WRF-Lake model in the Laurentian Great Lakes

Journal of Advances in Modeling Earth Systems (5.6)

C. Xiao, B. M. Lofgren, J. Wang, P. Y. Chu (OAR/GLERL)

- After incorporating a sophisticated treatment of lake surface albedo, the new lake model produces a more reasonable LST and LIC than the default lake



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model, indicating that the processes of ice melting and snow accumulation are important to simulate lake ice in the Great Lakes.

In this study, a one-dimensional (1-D) thermal diffusion lake model within the Weather Research and Forecasting (WRF) model was investigated for the Laurentian Great Lakes. In the default 10-layer lake model, the albedos of water and ice are specified with constant values, 0.08 and 0.6, respectively, ignoring shortwave partitioning and zenith angle, ice melting, and snow effect. Some modifications, including a dynamic lake surface albedo, tuned vertical diffusivities, and a sophisticated treatment of snow cover over lake ice, have been added to the lake model. A set of comparison experiments have been carried out to evaluate the performances of different lake schemes in the coupled WRF-lake modeling system. Results show that the 1-D lake model is able to capture the seasonal variability of lake surface temperature (LST) and lake ice coverage (LIC). However, it produces an early warming and quick cooling of LST in deep lakes, and excessive and early persistent LIC in all lakes. Increasing vertical diffusivity can reduce the bias in the 1-D lake but only in a limited way. After incorporating a sophisticated treatment of lake surface albedo, the new lake model produces a more reasonable LST and LIC than the default lake model, indicating that the processes of ice melting and snow accumulation are important to simulate lake ice in the Great Lakes. Even though substantial efforts have been devoted to improving the 1-D lake model, it still remains considerably challenging to adequately capture the full dynamics and thermodynamics in deep lakes.

Publication date: December 22, 2016

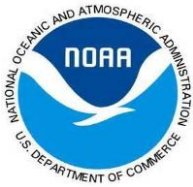
Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016MS000717/full>

Using calls as an indicator for Antarctic blue whale distribution and occurrence across the southwest Pacific and southeast Indian oceans

Marine Mammal Science (1.665)

N. E. Balcazar (OAR/PMEL), H. Klinck (OAR/CPO), S. L. Nieukirk (OAR/CPO), D. K. Mellinger (OAR/CPO), K. Klinck (OAR/CPO), R. P. Dziak (OAR/PMEL), T. L. Rogers

- This study documented, for the first time, the occurrence and distribution of the critically endangered Antarctic blue whale in the southwest Pacific Ocean.
- We detected Antarctic blue whale calls in previously undocumented SWPO locations off eastern Australia.
- Antarctic blue whales were present nearly year-round in some areas.



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Understanding species distribution and behavior is essential for conservation programs of migratory species with recovering populations. The critically endangered Antarctic blue whale (*Balaenoptera musculus intermedia*) was heavily exploited during the whaling era. Because of their low numbers, highly migratory behavior, and occurrence in remote areas, their distribution and range are not fully understood, particularly in the southwest Pacific Ocean. This is the first Antarctic blue whale study covering the southwest Pacific Ocean region from temperate to tropical waters (32°S to 15°S). Passive acoustic data were recorded between 2010 and 2011 across the southwest Pacific (SWPO) and southeast Indian (SEIO) oceans. We detected Antarctic blue whale calls in previously undocumented SWPO locations off eastern Australia (32°S, 152°E) and within the Lau Basin (20°S, 176°W and 15°S, 173°W), and SEIO off northwest Australia (19°S, 115°E). In temperate waters, adjacent ocean basins had similar seasonal occurrence, in that calling Antarctic blue whales were present for long periods, almost year round in some areas. In northern tropical waters, calling whales were mostly present during the austral winter. Clarifying the occurrence and distribution of critically endangered species is fundamental for monitoring population recovery, marine protected area planning, and in mitigating anthropogenic threats.

Publication date: December 12, 2016

Available online: <http://onlinelibrary.wiley.com/doi/10.1111/mms.12373/full>

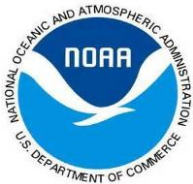
Zonal evolution of Alaskan Stream structure and transport quantified with Argo data

Journal of Geophysical Research: Oceans (3.44)

P. D. Logan and **G. C. Johnson (OAR/PMEL)**

- Provides improved description of the Alaskan Stream (AS) flow using Argo float array to quantify AS evolution from 140°W to 175°W
- Flowing west from its formation region at 140°W–145°W the full-depth AS becomes stronger, more barotropic, and also narrower once it reaches ~160°W, with along-shore transports increasing

The Alaskan Stream (AS) flows west-southwestward along the south side of Alaska and the Aleutian Island Arc; a western boundary current at the northern edge of the North Pacific subpolar gyre. The Argo float array has improved sampling of the Gulf of Alaska, allowing quantification of the AS's zonal evolution from 140°W to 175°W. Geostrophic along-shore transport of the AS in the upper 1000 dbar referenced to an assumed level of no motion at 1000 dbar shows little change from east to west. However, along-shore absolute geostrophic transports in



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the top 2000 dbar (obtained by combining mean absolute 1000-dbar velocities from float displacements with the geostrophic velocity fields) generally increase to the west. We estimate full-depth transports by fitting a barotropic and the first two baroclinic modes calculated from a climatology to the absolute geostrophic velocities in the upper 2000 dbar and applying the velocities from these fits from 2000 dbar to the seafloor. Flowing west from its formation region at 140°W–145°W the full-depth AS becomes stronger, more barotropic, and also narrower once it reaches ~160°W, with along-shore transports increasing from -16.4 ± 4.9 Sv (1 Sv = 106 m³ s⁻¹) at 140°W to -32.6 ± 5.2 Sv at 175°W. Mean concentrations of relatively warm, salty, oxygen-poor, and nutrient-rich Pacific Equatorial Water (PEW) in the AS decrease from $17.8 \pm 0.3\%$ to $8.5 \pm 0.5\%$ between 140°W and 175°W. However, the volume transport of PEW by the AS exhibits little change over the PEW density range between these longitudes.

Publication date: December 26, 2016

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016JC012302/full>

NWS Publications

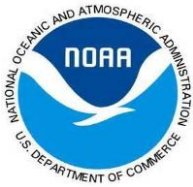
A LAMP/HRRR Meld for improved aviation guidance

Weather and Forecasting (1.972)

B. Glahn, A. D. Schnapp, J. E. Ghirardelli, J.-S. Im (NWS/MDL)

- This paper reports the first LAMP use of a dynamic mesoscale numerical model in producing forecasts of ceiling and visibility. The new products, currently in the implementation process at NCEP, show marked improvement over the previous products.
- This LAMP/HRRR Meld process points the way to improvement in other weather element forecasts, and to the expansion of ceiling and visibility forecasts to other cloud layers.

LAMP (Localized Aviation MOS Program) forecasts of ceiling height, visibility, wind, and other weather elements of interest to the aviation community have been produced and put into the NDGD (National Digital Guidance Database) since 2006. The HRRR (High-Resolution Rapid Refresh) model is now producing explicit forecasts of ceiling height and visibility computed by algorithms based on variables directly forecasted by the HRRR. The Meteorological Development Laboratory has improved the LAMP ceiling and visibility forecasts by combining these two sources of information into a LAMP/HRRR Meld. The new forecasts show improvement over the original LAMP and particularly over the HRRR and persistence in terms of bias, threat score, and the Gerrity Score. This paper



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explains how the Meld is produced and shows selected verification and example forecasts. A new guidance product based on this work will be made available to partners and customers.

Published online: December 7, 2016

Available online at: <http://journals.ametsoc.org/doi/abs/10.1175/WAF-D-16-0127.1>

NESDIS Publications

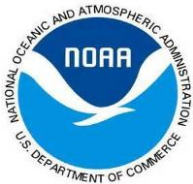
Validation of the effect of cross-calibrated GOES solar proton effective energies on derived integral fluxes by comparison with STEREO observations

Space Weather (2.846)

J. V. Rodriguez (NESDIS/NCEI), I. Sandberg, R. A. Mewaldt, I. A. Daglis, P. Jiggins

- NOAA GOES and NASA STEREO spectra agree well during the December 2006 solar proton events when GOES channel effective energies are used that are derived from cross-calibrations with the NASA IMP-8 GME instrument.
- Current GOES integral fluxes are too high by up to a factor of 3.

The derivation of integral fluxes from instrument coincidence rates requires accurate knowledge of their effective energies. Recent cross-calibrations of GOES with the high-energy-resolution IMP-8 Goddard Medium Energy Experiment (GME) [Sandberg et al., Geophys. Res. Lett, 41, 4435, 2014a] gave significantly lower effective energies than those currently used by the NOAA Space Weather Prediction Center to calculate solar proton integral fluxes from GOES rates. This implies systematically lower integral fluxes than currently produced. This paper quantifies the differences between the current and the cross-calibrated GOES integral fluxes and validates the latter. Care is taken to rule out the spectral resolution of the measurements or different integration algorithms as major contributors to differences in the magnitudes of the derived integral fluxes. The lower effective energies are validated by comparison with the independent, high-resolution observations by the STEREO Low-Energy Telescope (LET) and High-Energy Telescope (HET) during the December 2006 solar proton events. The current GOES product is similar to the >10 MeV integral fluxes recalculated using the Sandberg et al. [2014a] effective energies but is substantially greater at higher energies. (The median ratios of the current to the recalculated fluxes are 1.1 at >10 MeV, 1.7 at >30 MeV, 2.1 at >60 MeV and 2.9 at >100 MeV.) By virtue of this validation, the cross-calibrated GOES integral fluxes should be considered more accurate than the current NOAA product. The results of this study also demonstrate



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good consistency between the two long-term IMP-8 GME and STEREO LET and HET solar proton data sets.

Publication date: December 13, 2016

Available online: <http://onlinelibrary.wiley.com/doi/10.1002/2016SW001533/full>

OTHER REPORTS, BOOK CHAPTERS, AND INTERNAL PUBLICATIONS

NOS Publications

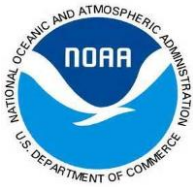
qPCR assays for Alexandrium fundyense and A. ostenfeldii identified from Alaskan coastal waters and a review of species-specific Alexandrium molecular assays

Phycologia (0.88)

M. W. Vandersea, S. R. Kibler, S. B. Van Sant, P. A. Tester, K. Sullivan, G. Eckert, C. Camarata, K. Reece, G. Scott, A. Place, K. Holderied, D. Hondolero, R. W. Litaker (NOS/NCCOS)

- *Alexandrium fundyense* is responsible for producing saxitoxins that cause paralytic shellfish poisoning (PSP) in Alaska.
- *Alexandrium ostenfeldii* is also present in Alaska. This species role in causing PSP in Alaska is unclear.
- A quantitative molecular assay to identify *A. fundyense* in phytoplankton and sediment samples was developed and validated.

Paralytic shellfish poisoning (PSP) poses a serious health threat in Alaska and prevents effective utilization of shellfish resources by subsistence and recreational harvesters. Substantial economic losses also impact shellfish growers during PSP events. The toxins responsible for PSP are produced by dinoflagellates in the genus *Alexandrium*. Despite the persistent threat posed by PSP and the long history of shellfish toxicity research, there is still confusion concerning the *Alexandrium* species that cause PSP in Alaska. The primary objective of this study was to identify the toxic *Alexandrium* species present in Alaska and to develop PCR assays for use in screening phytoplankton and sediment samples. Prior to developing the PCR assays for this study, we evaluated published assays and many were not adequate due to primer dimer formation or because of cross reactivity. Rather than continue to grapple with the uncertainty and inadequacy of published assays, we developed new assays for the *Alexandrium* species most likely to be present in Alaska. Only *Alexandrium fundyense* and *A. ostenfeldii* were identified from each of the four sampling regions from southeast Alaska to Kodiak Island, indicating that these two species are widely distributed. PCR assays for these two



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species were converted to qPCR format for use in monitoring programs. As part of this study, we realized that a systematic evaluation of *Alexandrium* species-specific assays would be of benefit. Toward this objective, we collated published *Alexandrium* PCR, qPCR, and in situ hybridization assay primers and probes which targeted the SSU, ITS/5.8S or D-D3 LSU (SSU/ITS/LSU) rDNA genes. Each individual primer or probe was screened against the GenBank database and *Alexandrium* gene sequence alignments were constructed as part of this study. These data were used to identify a suite of species-specific *Alexandrium* assays that can be recommended for evaluation by the global community.
Acceptance date: December 5, 2016

Geodetic Survey of NIST Clock Laboratories

NOAA Technical Memorandum

D. van Westrum (NOS/NGS)

- Precise (sub-centimeter) geopotential determinations in multiple optical clock laboratories will allow for precise confirmation of the clocks' performance as predicted by General Relativity. In the future, such clocks could be linked over continents, revolutionizing the field of geodesy.

Einstein's theory of general relativity tells us that if we move any clock "up" to a location with lower gravity (for example, away from the center of the earth), it will run faster. The effect is far too small to notice with typical clocks, but scientists at the National Institute of Standards and Technology (NIST) are now developing atomic clocks with such precision that a change in height as small as 1 centimeter will cause a noticeable difference!

To help them test and compare these clocks, National Geodetic Survey surveyors performed a first-order geopotential (height and gravity) survey of atomic clock laboratories in Boulder, Colorado. This provided orthometric heights ("above sea level") accurate to a few millimeters, and absolute gravity values accurate to nine digits. The hope is that one day the process can be "reversed" and, by networking similar clocks, height (or, actually, geopotential) differences can be measured directly with time.

Expected publication date: January 2017